

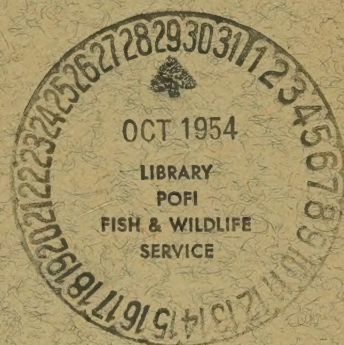
海洋生物時報

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昭和二十八年三月

BULLETIN
of
THE MARINE BIOLOGICAL STATION
OF ASAMUSHI

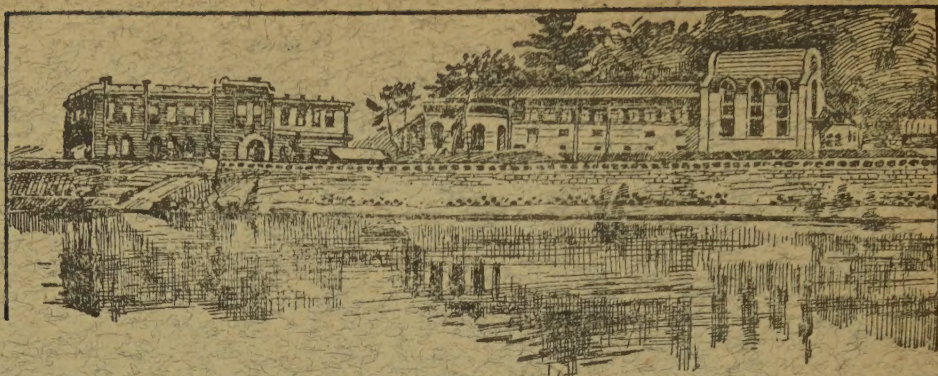
Vol. 6, Nos. 1-4
(March, 1953)



Asamushi, Aomori Prefecture
JAPAN

東北大學淺虫臨海實驗所

青森縣・淺虫



The Marine Biological Station of Asamushi

The Marine Biological Station is situated at Asamushi, Aomori Prefecture, one of the most delightful summer resorts in northern Japan, providing not only an excellent sea bathing, but also hot spring close to the shore. The station is near the Asamushi Railway Station, on the Tôhoku Main Line, a journey of about 22 hours from Tôkyô.

The Marine Biological Station was founded in July 1924 as an extension of The Institute of Biology, Tôhoku University. Although the primary object in building the station was to facilitate the work of the students, as well as the faculty, of Tôhoku University, it welcomed from the start all outside investigators. We welcome investigators at any season, though naturally summer and autumn are the season of greatest activity. The boarding house and official residences are open all the year round for the convenience to any one wishing to do research work.

The laboratory is well equipped with various kinds of apparatus commonly used for biological purpose. All the laboratory materials are free for use, except an excessive amount of expensive matter would be used. Visiting investigators are requested to communicate beforehand the nature of their research, duration of stay etc. to the director. Investigators are permitted to stay in the boarding house of the station, provided the cost of meals is paid.

Prof. Seiji Kokubo.

Director of
Marine Biological Station of Asamushi.

All communications intended for our publications should
be addressed to Prof. S. Kokubo, Marine Biological Station.

Asamushi, Japan.

海 洋 生 物 時 報

第 六 卷

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B U L L E T I N

of

THE MARINE BIOLOGICAL STATION OF

ASAMUSHI

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Report on the Temperature and Chlorinity of the Waters off Asamushi during 1951.

By

Bunryû Tsubata

(With 2 Text-figures and 2 Tables)

I. Introduction

Since 1927, observations have been made twice a month by members of the Marine Biological Station of the Tôhoku University at a definite station off Asamushi. The results of hydrographical observation have so far been described particularly by Hatai & Kokubo (1928), Kokubo (1931, 1932, 1952), Kokubo & Tamura (1934, 1938), Kawamura (1945-49, 1952), Okitsu (1945-49, 1952) and Tokui (1945-49, 1952).

In the present article, the results of observations made during 1951 are reported. Though the observations during 1951 were made by Kokubo, Kawamura, Okitsu and Tokui, the data concerning temperature and chlorinity were submitted to the writer because of the transfer of Kawamura and Tokui elsewhere. The method of observation was essentially the same as that in the former investigations. As shown in Table 1, nineteen series of observations were made during the period from January to December.

The writer offers his hearty gratitude to Prof. Dr. S. Kokubo, the Director of the Marine Biological Station, Tôhoku University, for his valuable suggestions and criticisms.

II. Results

1) Water Temperature

In 1951 the minimum temperature was found to occur during the period from late February to early March, but due to the lack of observation in September, the date of maximum is not certain, though it had to be found by late August. The curves of Fig. 1 is more or less corrected, reference being made also to the data of preceding years,

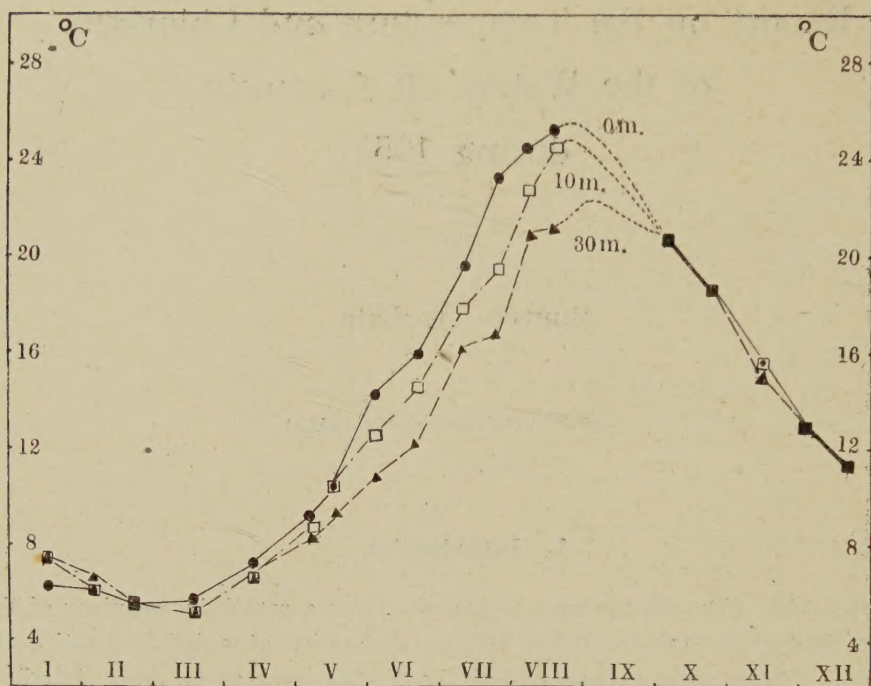


Fig. 1. Annual change of temperature at different depths during 1951. Ordinate - temperature, Abscissa - month.

In Aomori Bay it is notable that there occur direct and indirect stratification every year. In this connection, Kokubo & Tamura (1934, 1938) stated that "the year is divided into two periods, the earlier one showing the period of indirect stratification, the latter the period of direct stratification," and that "it can roughly be said that in Aomori Bay the indirect stratification ranges from October to March, and the direct stratification from April to September." This year, the indirect stratification was observed during the period from January to February, though the gradient of temperature from surface to bottom was indistinct from October afterwards.

Referring to the past data, it was found noticeable that this year's temperature showed a rare example, showing no indirect stratification.

Comparing the temperature of 1951 to the averages of 1927-1951 in relation to the averages of every ten days, it was found that the temperature during January-April is lower than the average value, while it is higher than average after August 7th. (Table 2).

From Fig. 1, it can be seen that cold water below 6°C remained from late February till March, the period of minimum being relatively long.

Table 2. Comparison of the temperature of 1951 with those of 1927-1951.

Depth (m)	Difference								
	I-16	II-6	II-22	III-18	IV-13	V-7	V-16	VI 3	VI-21
0	-1.12	-0.62	-0.36	-0.64	-1.10	-0.68	-1.40	-0.06	-1.13
5	-0.48	-1.03	-0.39	-1.07	-0.85	+0.05	+0.08	+0.01	-1.04
10	-0.40	-1.87	-0.51	-1.01	-0.83	-0.08	+0.11	+0.23	-0.76
20	-0.52	-0.87	-0.57	-0.91	-0.70	+0.21	+0.36	-0.13	-0.24
30	-0.57	-0.35	-0.49	-0.94	-0.60	-0.39	+0.69	+0.30	-1.11
	VII-10	VII 24	VIII-7	VIII-17	X-5	X-24	XI-15	XII 3	XII 20
0	+1.26	+0.93	+1.55	+1.04	+0.57	+1.23	+1.40	+1.68	+1.14
5	+1.61	+0.62	+1.54	+1.28	+0.44	+1.15	+0.89	+1.94	+0.63
10	+1.71	-0.85	+1.61	+2.00	+0.47	+1.17	+0.59	+1.57	+0.59
20	+3.43	-0.93	+2.11	+1.97	+0.24	+1.03	+0.42	+1.41	+0.53
30	+2.65	-0.74	+1.95	+0.85	+0.38	+0.98	+0.10	+1.51	+0.18

2) Chlorinity

The change of chlorinity during 1951 (Fig. 2) shows that the chlorinity of surface layer is generally low and variable, while in 10-30 m layer it increases with the depth showing no change throughout the year.

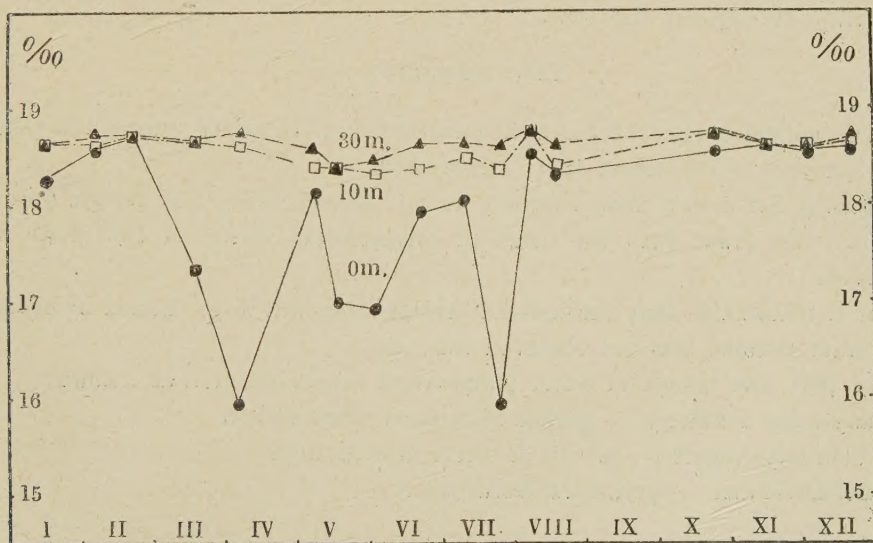


Fig. 2. Annual change of chlorinity at different depths during 1951. Ordinate - chlorinity in ‰, Abscissa-month.

During the period of direct stratification, from March to July, chlorinity of surface layer is lower than that in another period and shows considerable change, especially when the decrease appears in early April and late July. This fact coincides with the previous observations.

During the period from October to December the indirect stratification was not found, the quantity of chlorinity of 0m, 10 m and 30 m layer, showing almost the same value. From January to early February indirect stratification appears, chlorinity of surface layer being lower than in other layers.

As regards the above annual change, it is thought that the low chlorinity of surface layer from January to August, must be caused by the inflow of inland water into Aomori Bay, as it remains long unmixed with deep water, extending to a distance. The decrease of chlorinity will especially be influenced by the thaw water during April and also by the freshet of rivers during July. The period of October-December is the season of storm every year, strong wind mixing up the water of whole layer thus developing homogeneous condition.

Consequently it follow that in Aomori Bay in 1951, three different periods were noted, as follows:

January-early February — period of indirect stratification

late February-August — period of direct stratification

October-December — period of disturbance.

From above it is obvious that Aomori Bay is hardly influenced by oceanic current which invades into Mutsu Bay from Tsugaru Strait. This is also demonstrated by the fact that the chlorinity of 10-30 m layer of Aomori Bay remains invariably throughout the year.

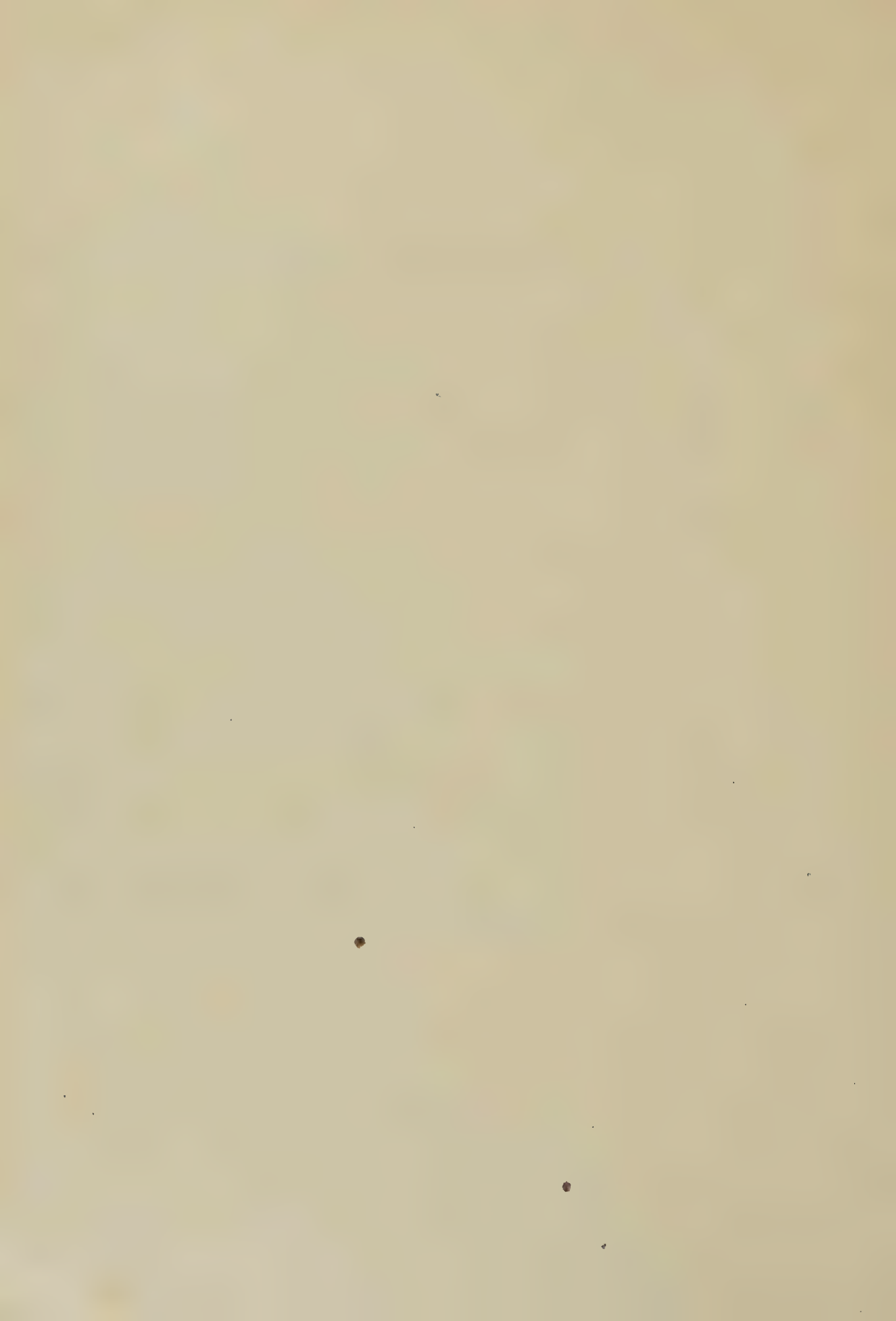
III. Summary

1. The annual change of water temperature and chlorinity during the period from January to December, 1951, was studied.
2. During the period from February to late March, 1951, cold temperature of 6°C, a value lower than the mean of corresponding season of 1927-1951 was observed.
3. It is remarkable that the indirect stratification which is common in average year after October was not observed this year.
4. In 1951, the change of water temperature can be denoted as follows ;
January-early February — period of indirect stratification
late February-August — period of direct stratification
October-December — period of disturbance.

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昭和26年度に於ける青森灣の植物性 プランクトンの季節的變化に就いて

沖 津 哲 三 郎

Observations on the Seasonal change of Phyto-
plankton in Aomori Bay during 1951

Tetsusaburō Okitsu

The present report deals with the seasonal change of phytoplankton in Aomori Bay during 1951.

The vernal increase of plankton diatoms occurred on March 18th, the leading species then being *Nitz. seriata* and *Ch. constrictus*. After that the volume of plankton decreased rapidly and in early July it reached the lowest value of the year.

However, during mid-August a considerable increase in quantity was again observed, the dominant species being *Ch. distans*. After this no fluctuations in volume were found till autumn, thus resulting in that the autumn increase of this year was very small. In Aomori Bay where the autumnal increase invariably occurs every year such a case seems to be rather uncommon, at least in so far as the data of past several years is concerned.

During mid-winter *Ch. socialis* and *Ch. debilis* which vegetated preceding years showed but little abundance, and *Cosc. Wailesii* occurred high in abundance. In late February the dominant species was *Nitz. seriata*, then followed by *Cosc. Wailesii*. During March and April the leading species was also *Nitz. seriata*, the second to this being *Ch. constrictus* and *Ch. debilis*, etc.

During June and July *Noctiluca* showed remarkable increase and the population of diatoms was relatively meagre. In August, however, diatoms rapidly flourished. The leading species in this case was *Ch. distans*. The second abundance was represented by *Ch. didy. v. angulicus* and *Ch. affinis*.

During October *Ch. affinis*, *Ch. curvisetus* and *Ch. siamense* occurred abundantly, the next being *Ch. compressus*, *Ch. Eibenii*, *Hemiaulus Hauckii* and *Thalassiothrix Frauenfeldii*. During this season the component of diatoms is characterised by tropical or sub-tropical species.

In November and December the warm water diatoms disappeared, the cold water species such as *Ch. socialis* and *Ch. debilis* appearing abundantly.

I. 緒 言

青森湾に於ける植物性プランクトンの季節的变化に就いては、小久保氏が 1946 年から 1950 年に亘つて詳細な研究を行つた。此の研究によつて、(1) 青森湾に於ける植物性プランクトンの季節的变化、(2) 秋期に此の湾に出現する熱帯性プランクトンは、湾内に流入する対馬駿流水塊の指標となる事、(3) 更に亦た湾内に出現する主要な硅藻類の生態の事などが明らかになつた (小久保, 1952)。

筆者も亦た 1951 年に於ける青森湾の植物性プランクトンの季節的変化を観察し、此の年はどのような季節的变化を示したかを、前年に於けるそれに比較検討してみた。此の報文は其の観察結果である。

プランクトンの採集地点、採集方法、ネット、プランクトンの定量法等は、小久保氏が海洋生物時報 Vol. 5 Nos. 1-4 に於いて述べられた事と全く同じであるから、之等の記載を省略した。

本文を草するに当り、実験の御指導と御校閲を辱うした東北大学教授小久保清治博士に深甚なる謝意を表する。

II. 観 察 結 果

(1) プランクトン量の季節的変化

今年に於けるプランクトン量の季節的变化は第 1 表、第 1 図に示す如くである。

Table 1. Quantity of Plankton during 1951

Date of Coll.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Oct.	Nov.	Dec.
	16 th	6 22 th nd	18 th	6 th	7 15 th th	3 21 rd nd	10 24 th th	7 17 th th	5 24 th th	15 th	3 20 rd th
Volume in cc.	11.5	8 10	177	81	34 17	33 16	4.5 10.5	19 63	51 59	75	27 43

1 月から 3 月初旬までは、プランクトン量は 8~12cc で著しく少なかつたが、3 月中旬になると急激に増加して、1, 2 月に於けるプランクトン量の約 20 倍に当る 180cc にも激増した。然しながら、此の増殖は約 20 日後の 4 月 6 日までに著しく減少して 80 cc になつた。3 月中旬の大増加は所謂『春の増加』であつて、之は明らかに *Nitzschia seriata* と *Chaetoceros constrictus* の増殖によるものであつた。

然しながら、8 月に入るとプランクトン量は増加し始め、中旬には 63cc になつた。此の時の優勢種は *Chaetoceros distans* であつた。8 月中旬から 11 月上旬までは、プランクトン量は 60cc 内外で差程の増減がみられなかつたが、11 月中旬には *Chaetoceros socialis* の増殖の爲めであらうか、少々増加して 75cc を示した。

今年の秋期のプランクトン量は、春期に比し多量ではあつたが、その増減が顕著でない。従つて今年の硅藻類の『秋の増加』は極く小さかつた。此の様な秋期のプランクトン量の変化は、1935 年に観察されて居るが (小久保, 1938)、青森湾としては特異な季節的变化である様に考えられる。

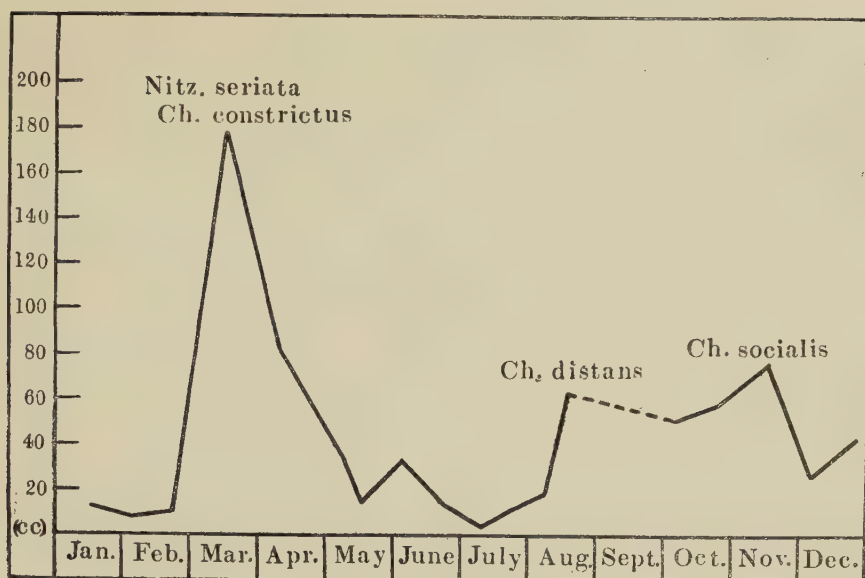


Fig. 1. Quantitative change of plankton during 1951.

(2) プランクトン組成の季節的変化

今年のプランクトン組成の季節的変化は第2表に示す如くである。

今年の1月乃至2月上旬には、数年の間優勢に出現して居た *Chaetoceros socialis*, *Ch. debilis* が比較的少なく、*Coscinodiscus Wailesii* が顕著に増殖して2月上旬には最多を示した。此の種類は boreal の性質を帯び、冬期間に時として大増加する種類であつて、最近では1949年の3月に優勢に出現して居る (小久保, 1952)。

1月中から僅かながら出現して居た *Nitzschia seriata* が次第に増加して、2月下旬には *Cosc. Wailesii* に代つて最多種になつた。*Nitz. seriata* は前年には3月上旬から増加し始め、4月下旬乃至5月に最も多かつたが、今年は2月下旬から4月に優勢で、その最多の時期は3月中旬であつた。即ち今年は昨年に比し約1ヶ月早く増加したが、その増殖の期間が短かつた。3月には *Nitz. seriata* の他に *Chaetoceros constrictus* が優勢であつた。*Coscinodiscus* 属は3月になると著しく衰滅し、*Cosc. Wailesii* は殆ど消失した。

4月には最多種は *Nitz. seriata* で、之に次いで *Chaetoceros debilis*, *Ch. constrictus*, *Skeletonema costatum* が多かつた。以上の他には *Chaetoceros radicans*, *Ch. compressus*, *Ch. decipiens*, *Bacteriastrium varians*, *Asterionella japonica* 等も稍々出現した。

6, 7月には植物性プランクトンは種類も数量も可なり貧弱であつた。稍々出現した種類は、6月には *Chaetoceros affinis*, *Ch. decipiens* (上旬), *Nitzschia seriata* (下旬), 等であり、また7月には *Nitz. seriata*, (上旬), *Ch. debilis*, *Ch. didy. v. angulicus*, *Ch. decipiens* (下旬), 等であつた。此の期間は一般にプランクトン量の少ない時期であつて、既述の様に今年は7月に年間の最低量を示した。昨年には6月にその最低量がみ

られた。また種類数も他の時期に較べて著しく少なかったが、昨年の6月には、*Chaetoceros* 属が僅かに 3, 4 種類、硅藻類全体としても 10 種内外と言う状態に比すれば今年は可成り多かった様である。6, 7 月にプランクトン量の少なかったのは硅藻類自体の繁殖が貧弱である事と、*Noctiluca* によつて硅藻類が飽食された事等によるものであらうと考えられる。

上記の様に硅藻類が頗る貧弱であつたが、之に反して動物性の *Noctiluca* が優勢に出現した。昨年には 6 月に大量に出現したが、7 月には稍々衰へ *Chaetoceros distans* の次位に減少した。即ち今年は昨年よりも優勢であつた様に考えられる。

8 月には *Noctiluca* は急激に減少して、之に代つて、*Ch. affinis*, が優勢に増加して来た。之に次いで *Ch. affinis*, *Ch. didy. v. angulicus* が多かった。また *Dactyliosolen tenuis*, *Ch. compressus*, *Ch. peruvianus* 等も可なり出現した。今月は夏期性の硅藻類として代表的な *Chaetoceros distans* を始め、優勢に出現した種類は殆ど暖期性の種類であつて、プランクトン組成は著しく暖期性になつて来た事が分る。

Ch. distans は 10 月までに著しく減少して、*Ch. affinis*, *Ch. curvisetus*, *Ch. siamense* 等が増加して来た。*Ch. distans* は昨年は 7 月頃から 10 月に亘つて顕著な増殖を示したが、今年は上述の様に 8 月に優勢であつたに過ぎなく、その繁殖が著しくなかった。

10 月には、上旬では *Chaetoceros affinis*, *Ch. curvisetus* が代表種で、之に次いで *Chaetoceros compressus*, *Hemiaulus Hauckii*, *Thalassiothrix Frauenfeldii* 等が多く、更にまた *Chaetoceros peruvianus*, *Ch. decipiens*, *Rhizosolenia alata*, *Rhiz. styliformis* 等も可なり出現した。下旬には *Chaetoceros siamense* が代表種で、*Chaetoceros Eibenii*, *Thal'rix Frauenfeldii* が之に次ぎ、*Chaetoceros didy. v. angulicus*, *Ch. decipiens*, *Ch. curvisetus*, *Rhizo. Stolterforthii*, *Biddulphia sinensis*, *Hemidiscus Hardmanianus* 等もまた可なり出現した。

此の月は青森湾に於けるプランクトン組成が最も暖海性を現はす時期であつて、主要な硅藻類は殆ど暖期性のものであるばかりでなく、熱帯性の種類が数多く出現する。熱帯性種で今回出現した種類は、*Chaetoceros diversus*, *Ch. messanensis*, *Rhizosolenia cylindrus*, *Bacteriastrium comosum* 等であつた。上記各種のうち *Ch. diversus*, *Bact. comosum* が最も普通に発見された。熱帯性プランクトンは 11 月に入ると著しく減少したが、*Ch. messanensis*, *Ch. pseudocurvisetus* 等が 12 月上旬頃まで出現した。此の事から見ると、12 月上旬頃もプランクトン組成は暖水塊の影響を可なり受けて居た様に考えられる。小久保氏 (1952) によると、秋期に出現する熱帯性プランクトンの種類、量によつて湾内に流入する対馬暖流の強弱を判断出来るだらうと言はれる。

11 月に入ると、寒期性の *Chaetoceros socialis* が急激に増加して年末に及んで居る。11 月中旬に於いてプランクトン量が稍々増加したのは主として此の種によるものであつた。上種に次いで *Ch. debilis*, *Ch. curvisetus*, *Leptocylindrus danicus* 等が優勢に出現した。此の期間のプランクトン組成は *Ch. socialis* の出現によつて著しく冬型に移行したが、此の反面未だ暖期性の種類が可なり出現し、且つ上記の様に純熱帯性のものも僅かながら発見され、プランクトン組成は可なり複雑であつた。

III. 摘 要

- 1). 本文は 1951 年に於ける青森湾の植物性プランクトンの季節的变化に就いての観察結果である。
- 2). 今年の硅藻類の『春の増加』は 3 月中旬に現はれ、その主要種は *Nitz. seriata*, 及び *Ch. constrictus* であつた。秋期にはプランクトン量の増減が少なく、所謂『秋の増加』は顕著でなかつた。
- 3). 今年の 1 月乃至 2 月中旬には *Cosc. Wailesii* が可なり優勢に出現した。2 月下旬から 4 月にかけては *Nitz. seriata* が主要な種であつた。
- 4). 6, 7 月頃は硅藻類の種類もその量も頗る貧弱であるのに反して、*Noctiluca* が優勢に出現した。
- 5). *Ch. distans* が 8 月に *Noctiluca* に代つて優勢に増殖したが、10 月までに殆ど消失した。今年は昨年に比しその増加は著しくなかつた。
- 6). 10 月に於ける主要種は *Ch. affinis*, *Ch. curvisetus*, *Ch. siamense* 等であつた。秋期に著しく出現した熱帯性の硅藻は 12 月上旬頃まで僅かながら発見された。

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Table II.

Seasonal occurrence of each species of Phytoplankton

No.	Species	1950	Jan.	Feb.		Mar.	Apr.		3rd
			16th	6th	22nd	18th	6th	13rd	
1	<i>Chaetoceros affinis</i>		RR	RR	RR	RR	RR	RR	+
2	<i>Ch. aff. f. singularis</i>								RR
3	<i>Ch. aff. f. circinalis</i>								
4	<i>Ch. atlanticus</i>		RR	RR	RR	RR	RR	R	
5	<i>Ch. borealis</i>							RR	
6	<i>Ch. brevis</i>								
7	<i>Ch. coarctatus</i>								
8	<i>Ch. concavicornis</i>					RR	RR		
9	<i>Ch. constrictus</i>		RR		R	C	+	RR	
10	<i>Ch. convolutus</i>					RR		RR	R
11	<i>Ch. compressus</i>		RR			RR		R	R
12	<i>Ch. costatus</i>								
13	<i>Ch. curvisetus</i>				RR	RR		RR	
14	<i>Ch. lanicus</i>								
15	<i>Ch. debilis</i>		+	R	+	+	C	R	R
16	<i>Ch. decipiens</i>		RR	RR	RR	RR	R	R	+
17	<i>Ch. decip. f. singularis</i>					RR	RR	RR	R
18	<i>Ch. denticulatus</i>								
19	<i>Ch. densus</i>		RR						
20	<i>Ch. didymus</i>		RR			RR	RR	RR	
21	<i>Ch. didy. v. angulicus</i>								
22	<i>Ch. distans</i>								
23	<i>Ch. diversus</i>								
24	<i>Ch. Eibenii</i>								
25	<i>Ch. Lauderii</i>								
26	<i>Ch. Lorenzianus</i>						RR	RR	
27	<i>Ch. messanensis</i>								
28	<i>Ch. peruvianus</i>		RR	RR	RR	R		RR	
29	<i>Ch. pelagicus</i>								R
30	<i>Ch. pseudocurvisetus</i>								
31	<i>Ch. radicans</i>					RR	R	RR	
32	<i>Ch. siamense</i>								
33	<i>Ch. similis</i>					RR			
34	<i>Ch. socialis</i>		+	+	+	+	RR	RR	R
35	<i>Ch. subsecundus</i>		RR	RR	RR	R	RR	RR	R
36	<i>Ch. teres</i>					RR	RR	RR	
37	<i>Ch. tortissimus</i>								
38	<i>Ch. Weissflogii</i>				RR				
39	<i>Actinopterychus undulatus</i>		+	R	RR	RR			
40	<i>Amphora sp.</i>		RR						
41	<i>Asterionella japonica</i>					RR	RR	R	
42	<i>Asteromphalus heptactis</i>								
43	<i>Ast. Cleveanus</i>								
44	<i>Ast. flabellatus</i>								
45	<i>Bacteriastrium comosum</i>								
46	<i>Bact. minus</i>								
47	<i>Bact. hyalinum</i>								
48	<i>Bact. varians</i>				RR	RR	R	R	R

[illegible]

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